MENTOR – Intelligent Mobile Online Peer Tutoring Application for Face-to-Face and Remote Peer Tutoring

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E-learning platforms have been increasingly adopted by universities to extend and enhance learning. However, the literature review has shown that limited research has been conducted on the effects of electronic peer tutoring on student learning. Correspondingly, there is a lack of a suite of technological affordances to facilitate online peer tutoring sessions and appointments remotely. This paper describes the development of a novel smartphone app – Mobile Education Networked Tutoring On Request (MENTOR) – to facilitate face-to-face and remote peer tutoring. The MENTOR app aims to predict the tutoring needs of students using tutor-tutee matching, provides coordination of face-to-face tutoring sessions via the use of smartphones' location data and online operation of remote tutoring sessions.

Keywords: Peer tutoring, predictive, prescriptive analytics, remote tutoring

Introduction

Recent studies have reported that peer tutoring is a cost-effective intervention that yields gains in academic and communication skills of the students (Song et al., 2018). Peer tutoring has the potential to provide pedagogical benefits to both tutor and tutee (Leung, 2015). According to Rosen (2011), face-to-face learning is increasingly complemented and partially supplanted by online or e-learning which appeals to the iGeneration. Harnessing iGeneration's aptitude towards electronic communication and learning would be advantageous towards students' learning, particularly peer-to-peer learning. Research has shown that peer tutoring at the university level could improve performance and enhance students' conceptual knowledge by reapplication of concepts (Colvin et al., 2010), raise motivation and learning (Simon et al., 2012), increase self-determination and learner autonomy (Carpenter et al., 1999) and improve student tutees' academic performance (Thomas, 2000). However, studies conducted on online peer tutoring within a dedicated online educational environment have received relatively little attention. One of the few studies is the on-campus/off-campus Peer Tutoring Electronic Network (OPTEN) model was developed by Jegede (2002) which utilized an online asynchronous text-based conference communication system for electronic peer tutoring. One of the major drawbacks of OPTEN is the arbitrary switching of tutor and tutee roles on a weekly basis without consideration of students' competency levels in the peer tutoring activities. Evans et al. (2013) attempted to address the issue of tutor-tutee mismatched by developing Online Peer-Assisted Learning (OPAL) web-based tutoring system that provides the tracking of statistical information about tutoring history called "tutoring tickets". These tutoring tickets listed the topics or problems the tutors had tutored previously as well as the timing and duration of past tutoring interactions. One of the weaknesses in OPAL tutoring process is that it relied on communication methods like email, Skype and Google Docs and OPAL's tutoring tickets did not indicate tutee feedback on tutors' teaching, which would be useful for optimizing the tutor-tutee matching.

Informed by the literature, we propose a new smartphone app with inbuilt predictive and prescriptive analytics called Mobile Education Networked Tutoring on Request (MENTOR) which analyzes students' academic profile and questionnaire responses to predict tutoring needs and prescribe suitable peer tutors. This paper describes the role of MENTOR in tutor-tutee matching and how tutees can be individually paired with tutors by the optimization rules and ranking algorithms via a web-based scheduling program. Tutor-tutee matching can be efficiently accomplished via the MENTOR app by granting tutees the choice of tutors based on student profile, subject topics, gender, tutor ratings and reviews received from past tutees. This development and research project emphasises the importance of online peer tutoring and aims to examine the learning processes of tutees via face-to-face and remote peer tutoring sessions offered by MENTOR. This project also aims to investigate the efficacy of location-based tutoring versus the traditional scheduled tutoring sessions. This project will also examine tutees' perceptions of the tutor-tutee matching offered by MENTOR versus the current scheduling approach. This paper presents the front-end needs analysis of MENTOR that helped identify some potentially useful features of the application.

Methods

We conducted the needs analysis and User Experience (UX) research with the current undergraduate student tutors and student tutees from various schools (Engineering, Education, Science, Business, Humanities, and Social Sciences) to align the student understanding and needs of the features for the proposed peer-to-peer smartphone app. UX research deals with the study, design, and evaluation of the experience the user has through the use of a system. According to Bargas-Avila et al. (2011), UX is used to describe and understand user's experience with interactive application which ranges from qualitative research of experiences with in-depth interviews to quantitative data from questionnaires. The use of UX paves the way in helping us to understand the background of the respondents, search for methods and correlates among ratings of technology perceptions to develop an innovative solution for peer tutoring. Specifically, MENTOR UX design incorporated the following to understand peer tutoring needs, user goals, user behaviors, and user experiences.

- **Service Blueprint** - Focuses on the user journey map, user steps and user journeys for peer tutoring.
- **Minimum Viable Product (MVP)** - MVP is used to design, develop and test MENTOR app to gain feedback for future iterations
- **Affinity Mapping** - Affinity Mapping is designed to cluster ideas and opinions in organizing information into groupings based on relations between small units.
- **User Personas** - Creation of User Personas to determine the goals, characteristics and represent the needs of a larger group of users (e.g. Tutors, Tutees, and Tutor Manager).

In this study, selected student tutors and tutees were interviewed to gain detailed insights into issues they faced as a tutor or tutee during traditional face-to-face sessions and their attitudes toward the use of a mobile app that electronically host peer tutoring sessions.

Results

Needs Analysis

Surveys were carried out using questionnaires collected from students studying in higher education to understand the needs of peer tutoring with tutors and tutees. The findings of the survey are shown in Figure 1 to 4. The needs analysis was carried out with 616 students (314 male, 302 female) comprising undergraduate and postgraduate peer tutors and past tutees to study (i) the effectiveness of peer tutoring (Figure 1), (ii) challenges faced by student related to their study (Figure 2), (iii) the preferred features in regard to peer tutoring app (Figure 3) and (iv) attributes of a good tutor (Figure 4). The findings of the survey data in Figure 1 show that the majority of the students are receptive to peer tutoring. This suggests that peer tutoring application as a user-friendly and intuitive method in helping to facilitate student learning. Figure 2 shows a large number of students who have experienced peer tutoring reported that they required help in tutorials (29.9%) and foundational knowledge (23.71%) in their studies. The results also revealed that students sought for examination tips (15.46%), quick crash course (11.34%) and around 10% of the respondents sought advice on their coursework. The findings in Figure 3 reveal the type of features the students prefer. As observed from Figure 4, good knowledge and communication skills (approachable), patient, responsive, respectful and the ability to identify learners' needs are the attributes found to be a good tutor. These attributes are useful for the prescriptive analytics in identifying tutors who have general skills required for the job of peer-tutoring.

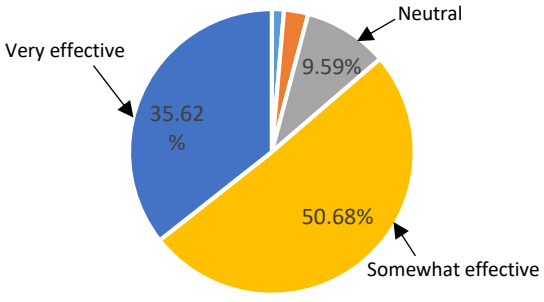

Figure 1: How effective do you think the peer tutoring program was in helping students?

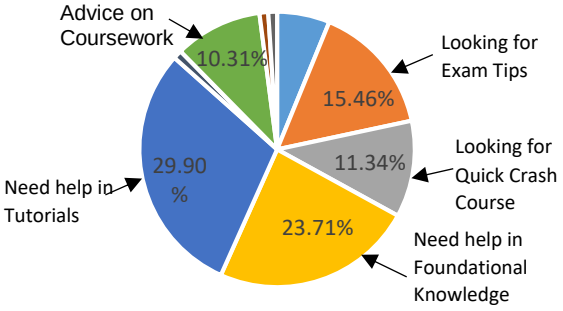

Figure 2: What influenced you to go for the peer tutoring program?

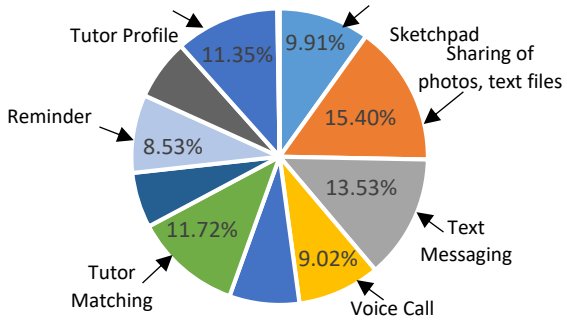

Figure 3: What features would you like to see in this mobile app?

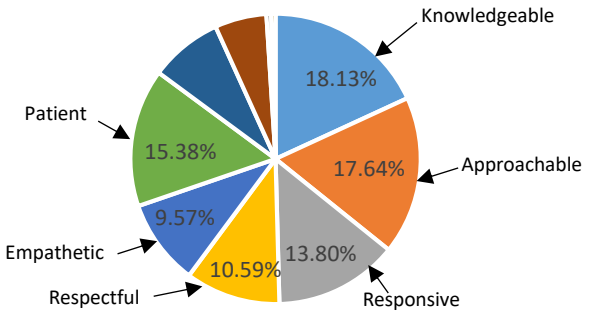

Figure 4: What are the attributes you would look for in a good tutor?

MENTOR Prototype

The proposed MENTOR application incorporates face-to-face (location-based) peer tutoring and remote peer tutoring (refer Figure 5 for a schematic of the MENTOR peer tutoring process). MENTOR app offers:

- **Face-to-face (location-based) peer tutoring** - Coordination of face-to-face tutoring sessions via location data of tutees and tutors is available when a tutee requires it. Tutees are able to link up to any proximal tutor to carry out face-to-face consultations.
- **Remote tutoring (online peer tutoring)** - Tutees can choose to have remote tutoring sessions via MENTOR's real-time, interactive screen sharing capability equipped with a digital sketchpad interface and accompanied by voice calls or instant messaging for tutor-tutee conversations.

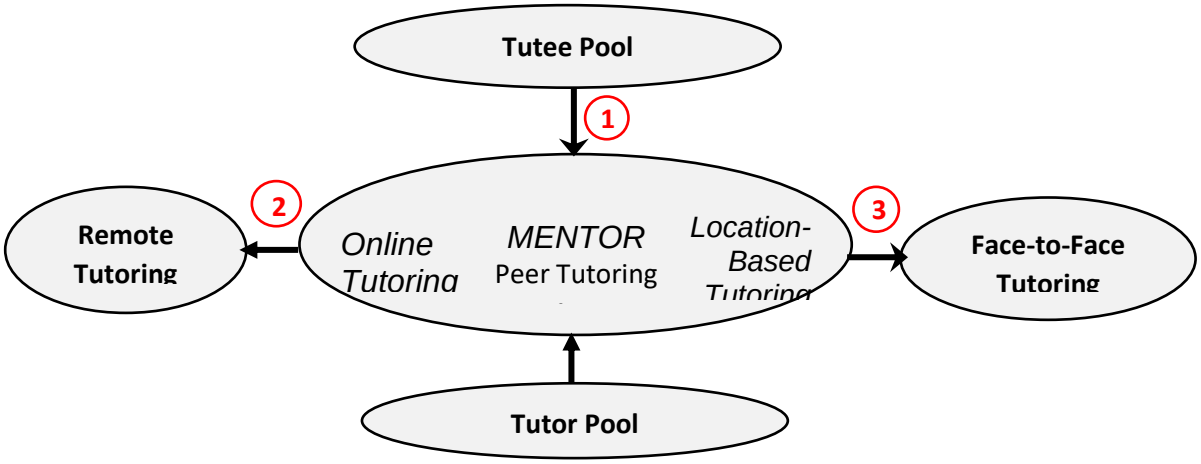

Figure 5: Schematic of the MENTOR peer tutoring process

- **MENTOR app**: Before tutees select remote tutoring or face-to-face tutoring, tutees answer an onboarding questionnaire which will help MENTOR predicts tutoring needs and prescribes relevant tutors according to the topic, gender, tutoring experience, and tutor ratings.
- **Remote Tutoring** is conducted via an interactive screen sharing feature in real-time on a digital sketchpad interface. Content can be uploaded to the sketchpad and viewed by tutor and tutee simultaneously.
- **Face-to-face tutoring**: Tutee seeking help can filter a list of tutor by a geo-tagging location-based map. Tutees can link up to any proximal tutor to have face-to-face tutoring sessions. Notifications are sent to the tutee, tutor and tutor manager once the peer tutoring session is confirmed.

Tutor-tutee Matching

The tutor-tutee matching provides the pairing of tutees' requests for a specific subject with respective tutors who have relevant expertise in terms of coursework and discipline. Matched and selected tutee-tutor pairs can arrange to meet at a convenient spot (within the campus) face-to-face based on the recommendations given by MENTOR app. Otherwise, tutees may choose to request for remote tutoring session at any time and place via MENTOR virtual platform. The optimization rules and ranking for predictive analytics (Figure 6) are derived from the scoring values of different input parameters extracted from student profile (e.g. year of study, school, programme, courses enrolled), topic, preferred gender, tutoring experience, and tutor ratings. The scoring value will be modeled with online questionnaire responses focusing on students' professed knowledge shortfalls and finally matched with mutual tutor-tutee availabilities to prescribe the right recommendation of tutors available.

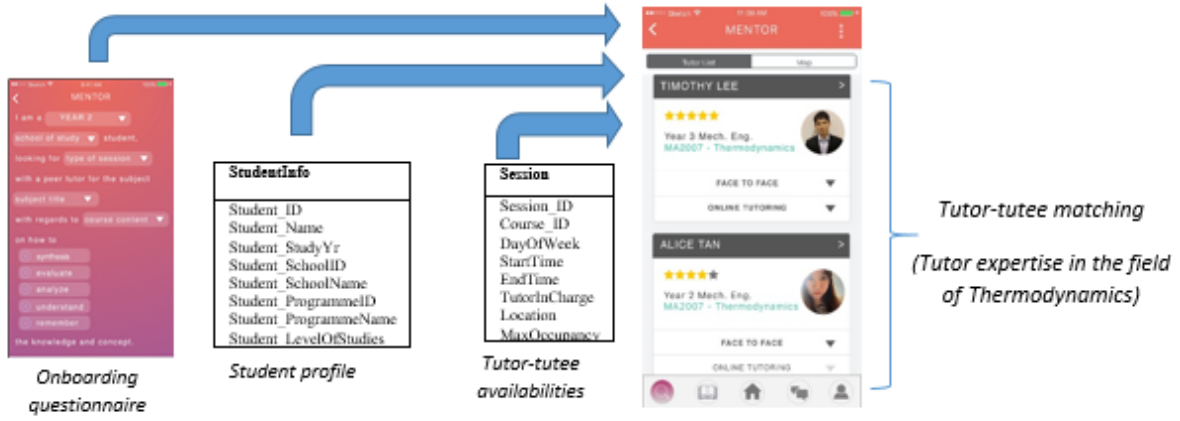

Figure 6: Tutor-tutee matching based on (i) *questionnaire* (ii) *student profile* (iii) *tutor-tutee availabilities*

Location-based Peer Tutoring (Face to Face)

The use of location-based tutoring is coordinated by a geo-tagging location-based map of both tutors and tutees. In the MENTOR app, geo-tagging enables proximity search and shows the proximal location of the most relevant and available tutors. Tutees can link up to any proximal tutor to have face-to-face tutoring sessions based on proximal locations of the three nearby tutors (Figure 7) thus accelerates the process of finding and receiving face-to-face tutor help as shown on MENTOR's location-based informative map.

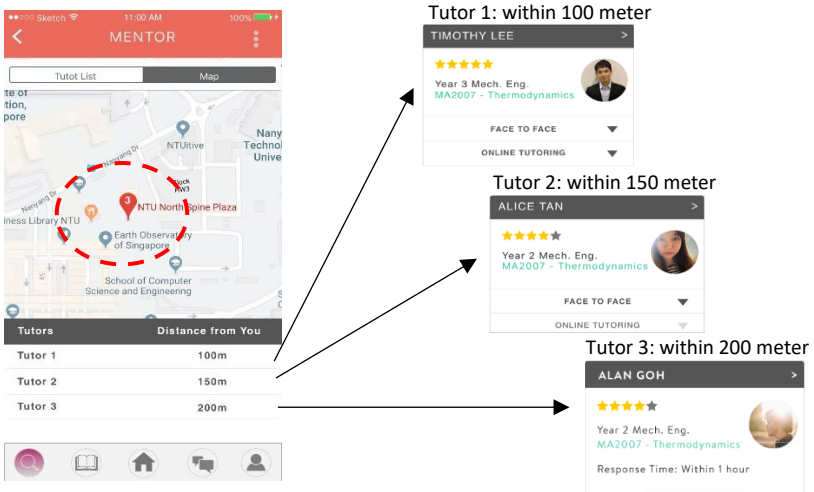

Figure 7: MENTOR's view of three tutors using geolocation proximity

Remote Tutoring

Remote tutoring is conducted via an interactive screen sharing feature in real-time communication on a digital sketchpad or whiteboard interface (Figure 8). Students can choose to have a remote tutoring session via MENTOR's real-time interactive screen sharing capability equipped with a digital sketchpad interface with the available tutor. The remote tutoring allows educational content to be uploaded and viewed by both tutor and tutee in real-time, accompanied by voice calls and instant messaging for tutor-tutee conversations. For example

- Tutor and tutee communicate using voice calls in the tutoring session to seek help for a particular problem.
- Tutor and tutee clarify their doubts using instant messaging, sketch mathematical formulas or equations and draw geometrical shapes in real-time. Comments and annotations by the tutor and tutee can be viewed by both parties simultaneously.

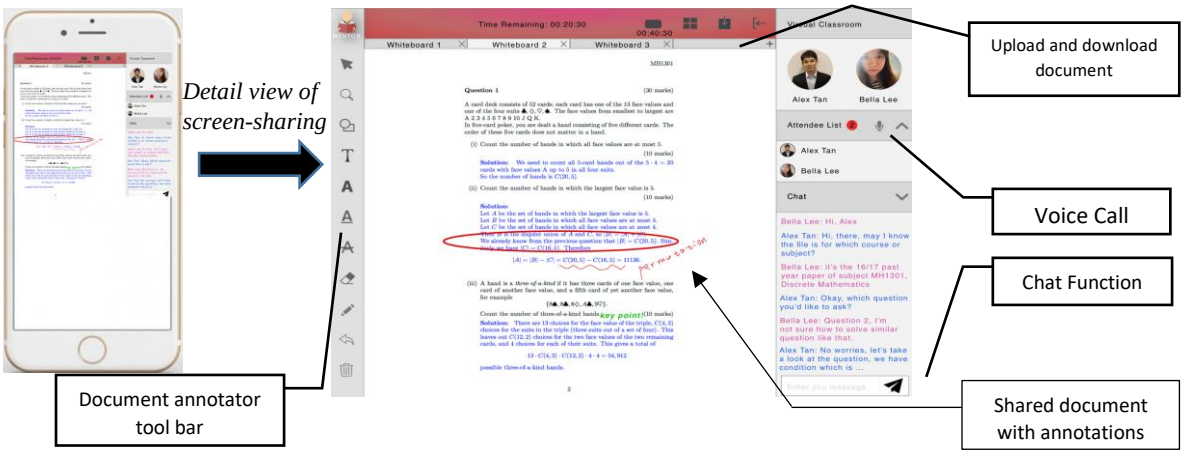

Figure 8: MENTOR's remote peer tutoring

Discussion and Future Work

In our initial study, it is hypothesized that facilitating peer tutoring online and offline via a smartphone may reap the combined benefits of e-learning and peer tutoring. The MENTOR app is a unique smartphone mobile application which can be customized and integrated with pre-existing school databases and learning management system (e.g. Blackboard Learn) as an app fully dedicated to education. In this study, the MENTOR peer tutoring model aims to integrate 'on-the-go' session booking based on student's location and remote peer tutoring using a smartphone (iOS and Android OS platform), making peer tutoring convenient, flexible in timing and location. This research provides an informative snapshot of the use of tutor-tutee matching, location-based information and real-time communication using remote tutoring. MENTOR has the potential as an intelligent peer tutoring model to generate knowledge and outcomes using predictive and prescriptive analytics. The findings of the needs analysis underlie the settings of the peer tutoring app and provide a structure in which the learning environment promotes the use of analytics for tutor-tutee matching to support and enhance learning. MENTOR application can be scalable to other higher education contexts to facilitate peer tutoring; maximizing the efficiency and efficacy of peer tutoring using expertise matching, expert locations, and automated coordination of peer tutoring sessions to achieve a closer match between students' perceptions of peer tutoring provided. MENTOR app can be extended to various educational institutions to facilitate peer tutoring, from primary, secondary schools, to tertiary institutions and universities.

Acknowledgement

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